ART 34 AMDT

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New Claims

1. A method for the surface treatment of workpieces in which said workpiece (12, 12', 12'') is worked at least in part by at least one roll (16, 16', 16''', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22', 76, 76', 78, 78') such that the treated surface (14, 14', 14'') of said workpiece (12, 12', 12'') is exposed to inherent compressive stresses and the zones located beneath said treated surface (14, 14', 14'') of said workpiece (12, 12', 12'') are exposed to inherent tensiles stresses axially and tangentially.

2. The method as set forth in claim 1, characterized in that said workpiece (12, 12', 12'') is moved in the axial direction by said at least one roll (16, 16', 16''', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22', 76, 76', 78, 78').

3. The method as set forth in claim 1 or 2, characterized in that said workpiece (12, 12', 12'') is worked by at least one, more particularly two, roll(s) (16, 16', 16''', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22', 76, 76', 78, 78') in sequence in the opposite direction.

4. The method as set forth in any of the claims 1 to 3, characterized in that said workpiece (12) having a round surface (14) is worked by at least one roll (16, 16', 16''') provided at least in part with an outer profile (22, 22') arranged parallel to said workpiece (12) and which is rotatable about the longitudinal centerline (18, 18',18''') thereof as well as about said workpiece (12).

5. The method as set forth in any of the claims 1 to 3, characterized in that said workpiece (12'') including at least one bore (14'') or similar opening is worked by at

least one roll (16, 16', 16''', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22') arranged parallel to said bore (14'') or similar opening and which is rotatable about said longitudinal centerline (18, 18«) as well as about said bore (14'') or similar opening.

6. The method as set forth in claim 4 or 5, characterized in that said workpiece (12, 12'') is worked by a roll (16, 16', 16''') provided at least in part with an outer profile (22, 22') and at least one, more particularly two, substantially non-profiled roll(s) (16'') arranged about said workpiece (12) or in said at least one bore (14'') or similar opening.

7. The method as set forth in claim 6, characterized in that said workpiece (12, 12'') is worked by a roll (16''') having an outer profile (22, 22') in the form of annular beads (24) and recesses arranged at an angle (α, α') to said longitudinal centerline (18, 18',18''') of said roll (16, 16', 16''', 74', 74'', 86', 86''), whereby said annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerline (18''') of said roll (16''') comprise a lead position substantially opposing each other.

8. The method as set forth in claim 4 or 5, characterized in that said workpiece (12, 12'') is worked by two rolls (16, 16') each provided at least in part with an outer profile (22, 22') and a substantially non-profiled roll (16'') arranged about said workpiece (12) or in said at least one bore (14'') or similar opening.

9. The method as set forth in claim 8, characterized in that said workpiece (12, 12'') is worked by two roll (16, 16') having an outer profile (22, 22'') in the form of annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerlines (18, 18') of said rolls (16, 16').

10. The method as set forth in claim 9, characterized in that said two rolls (16, 16') are powered in the same direction of rotation when said annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerlines (18, 18') of said two rolls (16, 16') comprise a lead position substantially opposing each other.

11. The method as set forth in claim 9, characterized in that said two rolls (16, 16') are powered in the opposite direction of rotation when said annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerlines (18, 18') of said two rolls (16, 16') comprise a lead position substantially the same to each other.

12. The method as set forth in any of the claims 1 to 3, characterized in that said workpiece (12') including at least one flat surface (14') is worked by at least one roll (74', 74'', 86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') arranged substantially perpendicular or at an angle β to said workpiece (12') and rotatable about the longitudinal centerline (80) thereof.

13. The method as set forth in claim 12, characterized in that said workpiece (12') is worked by at least one roll (74', 74'') provided at least in part with an outer profile (76, 76', 78, 78') and is worked or supported by at least one further roll (86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') or a non-profiled roll (86, 86''') or similar supporting means located spaced away and opposite said at least one roll (74', 74'').

14. The method as set forth in claim 13, characterized in that said surface (14') to be treated of said workpiece (12') is worked by said at least one roll (74', 74'', 86',

86'') including an outer profile (76, 76', 78, 78') in the form of annular beads (24) and recesses (26).

15. The method as set forth in claim 14, characterized in that said surface (14') of said workpiece (12') to be treated is worked by several rolls (74', 74'', 86', 86'') having an outer profile (76, 76', 78, 78') in the form of annular beads (94) and recesses (96), whereby said annular beads (94) and recesses (96) of adjoining rolls (74', 74'', 86', 86'') differ from each other in their configuration and arrangement and/or each of said adjoining rolls (74', 74'', 86', 86'') is powered in a different direction of rotation.

16. The method as set forth in claim 15, characterized in that said surface (14') of said workpiece (12') to be treated is worked by rolls (74'', 86'') having an outer profile (78, 78') in the form of annular beads (24) and recesses (26) arranged at an angle (α, α')to said longitudinal centerlines (80) of said rolls (74'', 86''), whereby said rolls (74'', 86'') are powered in the same direction of rotation for a substantially opposite lead position of said beads (24) and recesses (26) or in the opposite direction of rotation for a substantially same lead position of said beads (24) and recesses (26).

17. The method as set forth in claim 15 or 16, characterized in that said surface (14') of said workpiece (12') to be treated is worked by rolls (74',86') having an outer profile (76, 76') in the form of annular beads (94) and recesses (96) arranged perpendicular to their longitudinal centerlines (80), more particularly axially staggered relatively to each other.

18. The method as set forth in any of the claims 1 to 17, characterized in that said workpiece (12, 12', 12'') or said surface (14, 14') or said at least one bore (14'') or similar opening to be treated of said workpiece (12, 12',

12'') is coated with a covering of metal, such as chromium, copper or the like, and/or with a metal alloy and/or a paint and/or plastics and/or is anodized and/or galvanized and/or pickled.

19. A device for surface treatment of workpieces (12) having a round surface (14), more particularly for implementing the method as set forth in any of the preceding claims, comprising three rolls (16, 16', 16'', 16''') arranged parallel to and about said workpiece (12) provided at least in part with an outer profile (22, 22') configured in the form of annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerline (18, 18', 18''') of said roll (16, 16', 16''') working said surface (14) of said workpiece (12) and each rotatable about their longitudinal centerlines (18, 18', 18'', 18''') as well as in combination about said workpiece (12).

20. The device for surface treatment of workpieces (12'') having at least one bore (14'') or similar opening, more particularly for implementing the method as set forth in any of the preceding claims, comprising at least two, more particularly three rolls (16, 16', 16'', 16''') provided at least in part with an outer profile (22, 22') configured in the form of annular beads (24) and recesses (26) arranged at an angle (α, α') to said longitudinal centerline (18, 18', 18''') of said roll (16, 16', 16''') working said surface (14) of said workpiece (12) and each rotatable about their longitudinal centerlines (18, 18', 18'', 18''') as well as in combination about said workpiece (12) working said bore (14'') or similar opening and each rotatable individually about their longitudinal centerlines (18, 18', 18'', 18''') as well as in combination in said bore (14'') or similar opening.

21. The device as set forth in claim 19 or 20, characterized in that at least one roll, more particularly

two, rolls (16, 16', 16'') is/are provided at least in part with an outer profile (22, 22') working said workpiece (12, 12'').

22. The device as set forth in claim 21, characterized in that the remaining rolls, more particularly one roll (16''), are/is configured non-profiled.

23. The device as set forth in any of the claims 19 to 22, characterized in that said at least one, more particularly two roll(s) (16, 16', 16''') are provided at least in part with an outer profile (22, 22') working said workpiece (12, 12'') in sequence in the opposite direction.

24. The device as set forth in claim 23, characterized in that said one roll (16''') is provided with an outer profile (22, 22') in the form of annular beads (24) and recesses arranged at an angle (α, α') to said longitudinal centerline (18''') of said roll (16''') in a lead position substantially opposing each other.

25. The device as set forth in claim 23, characterized in that two adjoining rolls (16, 16') having an outer profile (22, 22') are drivable in the same direction of rotation for substantially an opposed lead position of said beads (24) and recesses (26) and in the opposite direction of rotation for substantially the same lead position of said beads (24) and recesses (26).

26. The device as set forth in any of the claims 19 to recesses 25, characterized in that said at least one roll (16, 16', 16''') is provided with non-profiled ends (30, 32).

27. The device as set forth in claim 26, characterized in that said non-profiled end (30) of said at least one roll (16, 16', 16''') incoming in said direction of movement of

said workpiece (12, 12'') comprises a slightly smaller outer diameter.

28. The device as set forth in claim 26 or 27, characterized in that said non-profiled end (32) of said at least one roll (16, 16', 16''') outgoing in said direction of movement of said workpiece (12, 12'') has a slightly larger outer diameter.

29. The device as set forth in any of the claims 19 to 28, characterized in that said rolls (16, 16', 16'', 16''') are mounted by a drive means (34) for rotating each of said rolls (16, 16', 16'', 16''') individually about their longitudinal centerlines (18, 18',18'', 18''') and by a drive head (36) or similar drive arrangement for rotating said rolls (16, 16', 16'', 16''') in combination about said workpiece (12) or in said at least one bore (14'') or the like of said workpiece (12'').

30. The device as set forth in claim 29, characterized in that each of said rolls (16, 16', 16'', 16''') is non-rotatably mounted by said drive means (34) by one end (30), more particularly via a section (38) and a correspondingly shaped recess (40) of said drive means (34), and is rotatably mounted by said drive head (36) or similar drive arrangement by one end (32).

31. The device as set forth in claim 29 or 30, characterized in that said drive means (34) and/or said drive head (36) is/are controllable hydraulically or pneumatically.

32. The device as set forth in any of the claims 29 to 31, characterized in that said drive means (34) comprises drive motors (46) each assigned to one of said rolls (16, 16', 16'').

33. The device as set forth in any of the claims 29 to 32, characterized in that said drive head (36) or similar drive arrangement is rotatable with a worm drive (48) powered more particularly via a separate drive motor (50).

34. The device as set forth in any of the claims 29 to 33, characterized in that said drive means (34) and said drive head (36) are configured movable relative to each other.

35. The device as set forth in claim 34, characterized in that said drive means (34) is longitudinally shiftable via a guide means (52) or the like and a mechanically, electrically, hydraulically or pneumatically actuatable drive element (54), more particularly a pressure cylinder or the like.

36. The device as set forth in any of the claims 29 to 35, characterized in that said drive means (34) and/or said drive head (36) is/are provided with a centering means (58) for said workpiece (12).

37. A device for surface treatment of workpieces (12«) having at least one flat surface (14'), more particularly for implementing the method as set forth in any of the preceding claims, comprising at least one roll (74', 74'', 86', 86'') arranged substantially perpendicular or at an angle β to the longitudinal direction (arrow 28) of said workpiece (12') which is provided with an outer profile (76, 76', 78, 78') configured in the form of annular beads (94) and recesses (96) of said at least one roll (74'') arranged at an angle (α, α') to the longitudinal centerline (80) thereof or annular beads (94) and recesses (96) arranged perpendicular working said surface (14') of said workpiece (12') at least in part and which is rotatable about the longitudinal centerline (80) thereof.

38. The device as set forth in claim 37, characterized in that said at least one roll (74', 74'') provided with an outer profile (76, 76', 78, 78') at least in part is assigned at least one further roll (86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') or non-profiled roll (86', 86'') or like supporting means opposite.

39. The device as set forth in any of the claims 37 to 38, characterized in that said at least one roll (74', 74'', 86', 86'') provided with an outer profile (76, 78) at least in part is followed by an additional roll (74', 74'', 86', 86'') provided likewise at least in part with an outer profile (76', 78') to work said surface (14') of said workpiece (12') in sequence in the opposite direction.

40. The device as set forth in claim 39, characterized in that said two rolls (74'', 86'') following each other comprise annular beads (94) and recesses (96) arranged at an angle (α, α') to the longitudinal centerlines (80) thereof, said two rolls (74'', 86'') being powered in the same direction of rotation when said annular beads (94) and recesses (96) comprise a lead position substantially opposing or in the opposite direction of rotation when said annular beads (94) and recesses (96) comprise a lead position substantially the same.

41. The device as set forth in claim 39 or 40, characterized in that said two rolls (74', 86') following each other comprise annular beads (94) and recesses (96) arranged perpendicular the longitudinal centerlines (80) thereof, said two rolls (74', 86') and/or said annular beads (94) and recesses (96) being axially staggered relative to each other.

42. The device as set forth in any of the claims 37 to 41, characterized in that at least one non-profiled roll

(74, 74''', 86', 86''') is provided upstream and/or downstream of said at least one roll (74', 74'', 86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') working said surface (14') of said workpiece (12') in the direction of movement of said workpiece (12').

43. The device as set forth in claim 42, characterized in that said at least one upstream non-profiled roll (74', 74''', 86', 86''') comprises a slightly smaller outer diameter.

44. The device as set forth in claim 42 or 43, characterized in that said at least one non-profiled downstream roll (74', 74''', 86', 86''') comprises a slightly larger outer diameter.

45. The device as set forth in any of the claims 19 to 44, characterized in that said annular beads (24, 94) protrude beyond the outer diameter of said at least one roll (16, 16', 74', 74'', 86', 86'').

46. The device as set forth in any of the claims 37 to 45, characterized in that said at least one roll (74', 74'') is mounted in a mounting means (72) movable relative to supporting means (84) supporting said workpiece (12').

47. The device as set forth in claim 46, characterized in that said mounting means (72) is adjustable relative to said supporting means (84) via a guide means (88) or the like and a mechanically, electrically, hydraulically or pneumatically actuatable drive element (90), more particularly a pressure cylinder or the like.

48. The device as set forth in claim 46 or 47, characterized in that said supporting means (84) comprises said at least one further roll (86', 86'') provided at least

in part with an outer profile (78, 78') or said non-profiled roll (86, 86''') or the like.

49. The device as set forth in any of the claims 46 to 48, characterized in that said mounting means (72) and/or said supporting means (84) is/are expediently hydraulically or pneumatically controllable.

50. The device as set forth in any of the claims 46 to 49, characterized in that said at least one (further) roll (74', 74'', 86', 86'') provided with an outer profile (76, 76' ,78, 78') at least in part and/or non-profiled is assigned in each case a separate drive motor (92).

51. The device as set forth in any of the claims 19 to 50, characterized in that said rolls (16, 16', 16''', 74', 74', 74'', 74''', 86, 86'', 86''') are configured multi-part, they more particularly being composed of a roll (60) as well as a sleeve (64) non-rotatively connected to said shaft (6) together with said outer profile (22, 22', 76, 76', 78, 78') provided at least in part, said smooth incoming end (30) and said smooth outgoing end (32) or with a smooth surface throughout.

52. The device as set forth in any of claims 19 to 51, characterized in that said rolls (16, 16', 16''', 74, 74', 74'', 74''', 86, 86', 86'', 86''') are coolable by an internal cooling system and/or an external cooling bath.

53. A method as set forth in any of the preceding claims for surface treatment of workpieces (12, 12', 12'') of metal, more particularly of base metals such as aluminum, lead, chromium, iron, cobalt, nickel, copper, manganese, molybdenum, silicon, tungsten, tin. zink or alloys thereof such as brass, preferably of steel and/or aluminum and/or alloyed aluminum such as for example, AlMg4.5Mn, AlMgSi0.5, AlMgSi, AlMg5, AlZn4.5Mg, AlCuMg, AlCuMg2, AlZnMgCu0.5,

AlznMgCu1.5, AlCuMgPb or of noble metals such as gold, palladium, platinum, silver or alloys thereof, or of combinations of base and noble metals.

54. The method as set forth in any of the claims 1 to 11 and 18 for producing elongated sections (12, 12') of solid metal, especially where hardened and/or coated, more particularly wires, rods and strip and/or tubular material, more particularly tubing, preferably headrest brackets in automobiles.

55. The method as set forth in any of the claims 1 to 11 and 18 for producing coiled, more particularly hardened and/or coated workpieces preferably coiled springs.

56. The method as set forth in any of the claims 1 to 11 and 18 for producing bores (14'') or similar openings, more particularly through-holes and/or blind holes in automotive engines.

57. The method as set forth in any of the claims 1 to 3 and 12 and 18 for producing elongated sections (12, 12') of solid metal, especially where hardened and/or coated, including at least one flat surface (14') more particularly rods and strip and/or tubular material, more particularly tubing, preferably headrest brackets in automobiles.

58. Use of a device as set forth in any of the preceding claims for surface treatment of workpieces (12, 12', 12'') of metal, more particularly of base metals such as aluminum, lead, chromium, iron, cobalt, nickel, copper, manganese, molybdenum, silicon, tungsten, tin. zink or alloys thereof such as brass, preferably of steel and/or aluminum and/or alloyed aluminum such as for example, AlMg4.5Mn, AlMgSi0.5, AlMgSi, AlMg5, AlZn4.5Mg, AlCuMg, AlCuMg2, AlZnMgCu0.5, AlznMgCu1.5, AlCuMgPb or of noble metals such as gold,

palladium, platinum, silver or alloys thereof, or of combinations of base and noble metals.

59. Use of a device as set forth in any of the claims 19, 21 to 36, 45, 51 and 52 for producing elongated sections (12, 12') of solid metal, especially where hardened and/or coated, more particularly wires, rods and strip and/or tubular material, more particularly tubing, preferably headrest brackets in automobiles.

60. Use of a device as set forth in any of the claims 19, 21 to 36, 45, 51 and 52 for producing coiled, more particularly hardened and/or coated workpieces preferably coiled springs.

61. Use of a device as set forth in any of the claims 19, 21 to 36, 45, 51 and 52 for producing bores (14'') or similar openings, more particularly through-holes and/or blind holes in automotive engines.

62. Use of a device as set forth in any of the claims 37 to 52 for producing elongated sections (12, 12') of solid metal, especially where hardened and/or coated, including at least one flat surface (14') more particularly rods and strip and/or tubular material, more particularly tubing, preferably headrest brackets in automobiles.